CLAIMS:

1. A component insertion head apparatus (61) for inserting a plurality of components (1) which are to be fed and in each of which a lead wire (3) is formed at each device portion (2), the components (1) including a first component and a second component lower in rigidity of the device portion than the first component, into a lead-wire insertion hole (6a) formed at a component insertion position in a board (6) by grasping the components one by one at a component grasping position, the component insertion head apparatus comprising:

a grasping unit (63) for releasably grasping the device portion of each of the components at the component grasping position; and

a grasping unit control section (509) for controlling grasping operation of the device portion of each of the components while controlling grasping pressure of the grasping unit and which is operable to control of each grasping pressure so that the grasping pressure for the second component becomes lower than the grasping pressure for the first component.

2. The component insertion head apparatus as claimed in Claim 1, wherein the grasping unit comprises:

a pair of grasping members (62a, 62b) which are disposed in opposition to each other and which are operable

grasping operation or grasping-release operation of the device portion of the component placed at the component grasping position by moving so as to approach or separate from each other; and

a grasping member driving section (71) for performing each move operation of approach or separation of the pair of grasping members.

3. The component insertion head apparatus as claimed in Claim 2, wherein in the grasping unit, the grasping member driving section comprises:

a cylinder portion (70) for performing each move operation of the pair of grasping members; and

a pressure-variable supply section (501 - 508) for supplying a fluid, which is to be supplied to the cylinder portion, with varying a pressure of the fluid, wherein

the grasping unit control section is operable to control the pressure-variable supply section so that a pressure of the supplied fluid for grasping of the second component by respective grasping members becomes lower than a pressure of the supplied fluid in grasping of the first component.

4. The component insertion head apparatus as claimed in Claim 1, wherein each of the grasping pressures is such a pressure which permits grasping and holding each device

portion of the first component or the second component without plastically deforming configuration of each device portion.

5. The component insertion head apparatus as claimed in Claim 1, wherein the second component is a component in which the rigidity of the device portion in a direction of the grasping is lower than the rigidity of the device portion of the first component in the same direction.

6. The component insertion head apparatus as claimed in Claim 1, comprising:

a lead wire guide unit (80) which has a guide pin (81), equipped with an engagement portion (81a) for engaging with an end portion of the lead wire of the component grasped by the grasping unit, for guiding the lead wire to the insertion hole of the board in engagement with the engagement portion to thereby insert the component into the board;

a pusher unit (65) for holding the engagement between the lead wire and the engagement portion by pressing the device portion of the component having its lead wire engaged with the engagement portion of the guide pin toward the insertion position in the board, and for pushing down the component guided by the guide pin so that the component is inserted into the insertion hole while maintaining the engagement state; and

a pusher unit control section (522) which is operable to control a push-down operation of each component while controlling a pressure for the pressing in the pusher unit, and which performs control on the pressure for each pressing so that the pressure for the pressing of the first component becomes lower than the pressure for the pressing of the second component.

7. The component insertion head apparatus as claimed in Claim 6, wherein the pusher unit comprises:

a pusher member (64) for making contact with the device portion of the component and moving up and down along a direction generally perpendicular to a surface of the board at the insertion position of the component; and

a pusher up/down moving unit (73) for performing up/down move of the pusher member.

8. The component insertion head apparatus as claimed in Claim 7, wherein in the pusher unit, the pusher up/down moving unit comprises:

a cylinder portion (74 and 75) for performing the up/down move of the pusher member; and

a pressure-variable supply section (514 - 521) for supplying a fluid to be supplied to the cylinder portion with varying a pressure of the fluid, wherein

the pusher unit control section is operable to control the pressure-variable supply section so that the

pressure of the supplied fluid in pressing of the device portion of the second component by the pusher member becomes lower than the pressure of the supplied fluid in pressing of the device portion of the first component.

9. The component insertion head apparatus as claimed in Claim 7, wherein

the lead wire guide unit comprises a lead wire bending portion (530) for bending the lead wire of the component to fix the component to the board while the component inserted into the insertion hole of the board has its device portion pressed and held at the insertion position of the board by the pusher member, and

the pusher unit control section performs control on pressure for each pressing so that a pressure for the pressing on the device portion in holding to the insertion position of the board by the pusher member becomes higher than a pressure for the pressing on the device portion in holding of the engagement between the engagement portion of the guide pin and the lead wire.

10. The component insertion head apparatus as claimed in Claim 6, wherein the pressure for each pressing is such a pressure that configuration of each device portion of the first component or the second component is not plastically deformed by the pressing.

11. The component insertion head apparatus as claimed

in Claim 9, wherein the pusher unit control section performs control on each of the pressures, for a third component having the lead wire whose rigidity is higher than those of the lead wires of the first component and the second component, so that a pressure for the pressing on the device portion in pressing and holding to the insertion position of the board by the pusher member becomes higher than the pressures for the pressing on the first component and the second component.

12. The component insertion head apparatus as claimed in Claim 6, wherein the second component is a component in which a rigidity of its device portion in a direction of the pressing is lower than a rigidity of the device portion of the first component in the same direction.

13. A component insertion apparatus comprising:

the component insertion head apparatus as defined in any one of Claims 1 to 12;

a component feed section (10) in which the components are stored so as to be feedable;

a component conveyor (20) for grasping the component fed from the component feed section and conveying the component to a component delivery position;

a transfer chuck (47) for grasping the component positioned at the component delivery position of the component conveyor and moving the component to a component

grasping position in the component insertion head apparatus; and

an alignment section (83) for performing positional alignment in a direction extending along a surface of the board between the component insertion head apparatus and the insertion position on the board.

14. A component insertion apparatus (101), comprising:

a component feed section (10) in which the plurality of components (1), which are radial components, are stored so as to be feedable;

a component conveyor (20) for grasping the component fed from the component feed section and conveying the component to a component delivery position;

a transfer chuck (47) for grasping the lead wire of the component positioned at the delivery position of the component conveyor and moving the component;

a component insertion section (60) equipped with the component insertion head apparatus (61) as defined in Claim 1 for inserting the lead wire of the component moved by the transfer chuck into the insertion hole (6a) for the lead wire formed in the insertion position for the component in the board (6); and

an alignment section (83) for performing positional alignment in a direction extending along a

surface of the board between the component insertion head apparatus and the insertion position in the board, wherein

the grasping unit (63) provided in the component insertion head apparatus includes a device chuck (62) for grasping the device portion of the component grasped by the transfer chuck and moved to the insertion position, and,

in the component insertion head, by the grasping of the device portion of the component by the device chuck, a bend of the lead wire is corrected on a fulcrum given by a grasping position of the lead wire by the transfer chuck so that the device portion comes to be positioned at the component insertion position, whereby correction of insertion posture of the component is performed, and the lead wire of the component that has been corrected in its insertion posture is inserted into the insertion hole of the board that has been aligned by the alignment section.

15. The component insertion apparatus as claimed in Claim 14, wherein

the component insertion section further comprises a guide pin (81) for holding an end portion of the lead wire of the component and guiding the held component so that the component becomes insertable into the insertion hole of the board, and

the component insertion head apparatus further includes a component push-out portion (64) for pushing out

the device portion of the component held by the guide pin toward the insertion position in the board, and concurrently inserting the lead wire into the insertion hole under the guide by the guide pin.

16. The component insertion head apparatus as claimed in Claim 14, wherein the move of the component from the delivery position in the component conveyor to the component insertion section by the transfer chuck is performed by rotation of the transfer chuck along the surface of the board, and the component insertion position aligned in the component insertion section is placed on a locus of the rotation of the transfer chuck with the component held by the transfer chuck at the delivery position.

17. The component insertion apparatus as claimed in Claim 16, wherein the rotation of the transfer chuck is performed at such a rotation angle that a positional shift amount between the component in the component insertion section and the component insertion position is corrected.

18. The component insertion apparatus as claimed in any one of Claims 14 to 17, wherein

each of the components that are the radial components has a plurality of the lead wires formed so as to be each arrayed in one line,

the device chuck includes a pair of grasping

plates (62a and 62b) which are disposed so as to be opposed to each other along the array direction of the lead wires of the component that has been placed at the component insertion position and for moving so as to approach or separate from each other, thereby performing grasping operation or grasping-releasing operation of the device portion, and

the device portion of the component that has been placed at the component insertion position is moved in a direction extending along the surface of the board and generally perpendicular to the array direction of the lead wires while the pair of grasping plates that have been away from each other are approaching each other, whereby the correction of the insertion posture of the component is performed and concurrently the grasping of the device portion by the pair of grasping plates is performed.

19. A component insertion method for inserting a plurality of components (1) in each of which a lead wire (3) is formed at each device portion (2), the components (1) including a first component and a second component lower in rigidity of the device portion than the first component, into a lead-wire insertion hole (6a) formed at a component insertion position in a board (6) by grasping the components one by one at a component grasping position and inserting each lead wire into the insertion hole so that

the first component and the second component are inserted into the board and compositely mounted thereon, the component insertion method comprising:

grasping the component releasably at the component grasping position so that a grasping pressure for the second component becomes lower than a grasping pressure for the first component;

along with the grasping of the component, performing positional alignment in a direction extending along a surface of the board between the lead wire of the component and the insertion hole of the board; and

thereafter, inserting the lead wire of the grasped component into the insertion hole of the board.

20. The component insertion method as claimed in Claim 19, further comprising:

after the grasping of the component, making an end portion of the lead wire of the component with an engagement portion (81a) of the guide pin (81) through the insertion hole of the board, and in pressing the device portion of the component toward the insertion position of the board by the pusher (64) to hold the engagement between the guide pin and the lead wire, holding this engagement by the pressing in such a manner that a pressure for the pressing of the second component becomes lower than a pressure for the pressing of the first component; and

releasing the grasping of the component and guiding the lead wire into the insertion hole by the guide pin so as to be inserted therein, while holding the engagement.

21. The component insertion method as claimed in Claim 20, wherein in fixing the component, which has been inserted in the insertion hole of the board, to the board by bending the lead wire of the component while the device portion is pressed and held at the insertion position of the board by the pusher member, each pressing is performed so that a pressure for the pressing on the device portion in the holding to the insertion position of the board by the pusher member becomes higher than a pressure for the pressing on the device portion in the holding of the engagement between the engagement portion of the guide pin and the lead wire.

22. The component insertion method as claimed in Claim 21, wherein each pressing is performed so that a pressure for the pressing on the device portion in the pressing and holding of a third component to an insertion position of the board by the pusher member, the third component having the lead wire higher in rigidity than the respective lead wires of the first component and the second component, becomes higher than a pressure for the pressing on the first component and the second component.

23. The component insertion method as claimed in Claim 19, wherein each of the grasping pressures is such a pressure which permits grasping and holding each device portion of the first component or the second component without plastically deforming configuration of each device portion.

24. The component insertion method as claimed in any one of Claims 20 to 22, wherein a pressure for each pressing is such a pressure that configuration of each device portion of the first component or the second component is not plastically deformed by the pressing.

25. The component insertion method as claimed in Claim 19, wherein the components are radial components (1), the method further comprising:

grasping the lead wire of the component and performing positional alignment in a direction along a surface of the board between the lead wire of the component and the insertion hole of the board;

along with that, grasping the device portion of the component whose lead wire has been grasped, thereby correcting a bend of the lead wire on a fulcrum given by the grasping position of the lead wire so that the device portion is placed at the component insertion position in the direction along the surface of the board, whereby correction of insertion posture of the component is

performed; and

inserting the lead wire of the component, which has been corrected in its insertion posture, into the insertion hole of the board.

26. The component insertion method as claimed in Claim 25, further comprising:

after the correction of the insertion posture of the component, holding an end portion of the lead wire of the component by a guide pin (81) through the insertion hole of the board, and further releasing the grasping of the device portion and the grasping of the lead wire; and

subsequently, moving the guide pin so that the end portion of the lead wire is guided to the insertion hole of the board, thereby inserting the lead wire of the component into the insertion hole.

27. The component insertion method as claimed in Claim 25 or 26, wherein

each of the components that are radial components has a plurality of the lead wires formed so as to be each arrayed in one line, and

the correction of the insertion posture of the component is performed by moving the device portion in a direction extending along a surface of the board and generally perpendicular to the array direction of the lead wires.